**Mr. Alpert’s Advanced Physics Investigation into Projectile Motion Using Animations**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In this exercise you will investigate how the angle of firing (inclination) affects the distance that a projectile travels (range), its maximum height, and how long it is in the air.

Go to the Phet site noted below. Click on download and then look for the file to appear in the lower left hand corner.

Open the file and investigate the following firing conditions noted in the data table. Fill in the data table.

When you have finished this exercise without air resistance, you are to **repeat it with air resistance** and fill in the last two columns. In the air resistance column, choose two objects such as a car and a football. <https://phet.colorado.edu/en/simulation/projectile-motion>

Questions for understanding:

1. What angle produces the greatest height?

2. Was this true with and without air resistance?

3. What angle produced the greatest range?

4. Was this true for both conditions (with air resistance and without)

5. What angle produced the longest time of flight? Was this with or without friction?

6. What is the name of the path of a projectile?

7. What is definition of a projectile?

8. What are the two components of a projectile’s flight pattern?

9. What are the characteristics of the component in the x direction? Go to the Physics Classroom to find out  
<http://www.physicsclassroom.com/Class/vectors/u3l2a.cfm>

10. What are the characteristics of the component in the y direction? Go to the Physics Classroom to find out

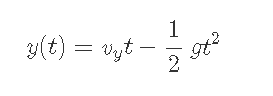
<http://www.physicsclassroom.com/Class/vectors/u3l2a.cfm>

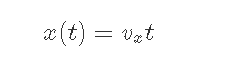
|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | WITHOUT AIR RESISTANCE (choose one projectile) | | | | WITH AIR RESISTANCE choose two objects in one box | | |
| Angle (degrees) | Initial velocity | Height (m) | Range (m) | Total time (s) | Height (m) | Range (m) | Total time (s) |
| 15 | 18 |  |  |  |  |  |  |
| 25 | 18 |  |  |  |  |  |  |
| 35 | 18 |  |  |  |  |  |  |
| 45 | 18 |  |  |  |  |  |  |
| 55 | 18 |  |  |  |  |  |  |
| 65 | 18 |  |  |  |  |  |  |
| 75 | 18 |  |  |  |  |  |  |

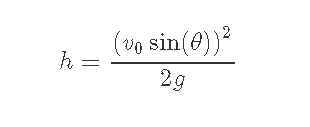
Alternate sites: <http://www.calctool.org/CALC/phys/newtonian/projectile>

simulator: <http://www.splung.com/content/sid/2/page/projectiles>

From the simulator site above splung, they cite the following formula:

This gives us the distance in the y direction if we accept a given initial velocity y component. Vy is the vertical component of a projectile. v times Sin Θ)

This equation gives us the range or horizontal distance of the projectile once we know the horizontal component of velocity (v time Cos Θ )



This equation on the above referenced site gives a derived equation for the height of the projectile if the angle and initial velocity are known.

Use the standard equations for height and compare your values to the height using the equation above (V SinΘ)^2/2g for the following:

A projectile fired at 45 degrees and initial velocity of 30 m/s

A projectile fired at 60 degrees and initial velocity of 20 m/s

A projectile fired at 20 degrees and initial velocity of 40 m/s

You must show your work!

Extra credit if you can show the deivation of the formula.